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PROJECTION FROM SITUATIONS

1 TWO APPROACHES TO DONKEY ANAPHORA

The following sentences contain anaphoric relations that are not amenable to a standard semantic analysis:

(1) Every man who owns a donkey pays taxes on it.

(2) Always, if a man owns a donkey, he pays taxes on it.

Such so-called *donkey anaphora* is the subject of a long and complex literature.[1] Here we hope to advance the discussion by showing that one of the two major extant strategies for treating donkey anaphora, the e-type strategy, suffers from a serious and hitherto unexplored problem. Solving the problem is possible, but pulls the e-type strategy much closer to its main competitor, the dynamic strategy.[2]

The e-type strategy, our critical focus, can be characterized by the following assumptions:

i) Definite descriptions have Fregean/Russellian semantics according to which 'the F is G' is true if and only if there is exactly one F and all Fs are Gs.

ii) The uniqueness and existence implications of definite descriptions are semantic presuppositions.[3]

iii) Donkey pronouns, such as 'it' in (1) and (2), are, semantically speaking, definite descriptions whose descriptive content is recovered in some way (pragmatically or syntactically, or both, on which more below) from context.[4]

[1] Dating from Walter Burley's medieval *De puritate artis logicae tractatus longior*, which gave the class of sentences their name and set the topic for example sentences ever since (though to our knowledge the addition of asinine assault was a purely twentieth century addendum), and including Geach [1962], Evans [1977b], Parsons [1978], Cooper [1979], Heim [1982], Kamp [1981], Neale [1990], Heim [1990], Ludlow [1994], Büring [2004], Elbourne [2005].

[2] The e-type and the dynamic strategy are not the only two, but are perhaps the most prominent approaches to donkey anaphora. 'E-type' is sometimes, confusingly, also used as a name for the phenomenon which we are calling 'donkey anaphora'; to be clear, we are using it here rather as the name for a particular theory of that phenomenon. We do not know the origin of the term.

[3] The idea that definite descriptions triggers presuppositions goes back to Frege and Strawson, but see Heim [1991] for an authoritative statement of it. While we assume the presuppositional view here, the data we consider also strongly support the presuppositional view of descriptions.

[4] There are some variations on this view on which pronouns are a special kind of definite description, as in Evans [1977b].

The e-type view contrasts with the rival dynamic view according to which definite descriptions and pronouns have a common variable-based semantics, differing only in their presuppositions.[5] On the dynamic view, both descriptions and pronouns behave like indexed variables and sentences such as (1) and (2) include co-indexed variables. The dynamic view (the internal working of which are beyond the scope of our discussion), also comes with a structured view of context that contains information about variables rather than just propositional information, and the view treats donkey anaphora by reference to intra-sentential changes in such structured contexts.[6]

2 UNIQUENESS

One of the main obstacles to the e-type treatment of donkey anaphora is that, according to the e-type theory, every definite description and every donkey pronouns gives rise to an often unsatisfied uniqueness presupposition. To give a flavor of the problem consider the following plausible ways of spelling out the descriptive content of the pronouns in (1) and (2):

(3) Every man who owns a donkey pays taxes on the donkey he owns.

(4) Always, if a man owns a donkey the man pays taxes on the donkey he owns.

On the e-type view, then, (1) and (2)—as well as (3) and (4)—should trigger a uniqueness presuppositions that every man who owns a donkey owns exactly one donkey.[7] But it has long been observed that they do not seem to have this presupposition. To make this especially clear, consider a sentence like Heim [1982]'s (5):

(5) Everyone who bought a sage plant bought eight others along with it.

At the risk of absurdity, (5) cannot presuppose that everyone who bought a sage plant bought exactly one sage plant.

One natural thought at this point is that the indefinite 'a donkey' filters the presupposition of 'the donkey'.[8] It is well known that material in the restrictor of quantifiers can filter presuppositions in their nuclear scope. A little reflection, however, shows that this response doesn't help: on e-type theories, 'a

[5] Thus, both dynamic and e-type views assimilate donkey anaphora and e-type descriptions, predicting similarities in their behavior. For this reason it can be misleading to call the e-type view a *descriptive view* or characterize it as simply the view that donkey anaphora have the semantics of definite descriptions, which is common to both views; what is crucial is the e-type view gives a Fregean/Russellian semantics for descriptions, and, hence, donkey pronouns.

[6] Heim [1982] and Kamp [1981] independently developed the classic version of this view, see Beaver [2001] and Nouwen [2003] for some more recent developments of the view. Dekker [1994] and Rothschild [2017] provide close alternatives that hew more closely to standard semantic assumptions.

[7] For now the distinction between a presupposition and entailment is not important: what is crucial here is that for the sentences to be true for the e-type theorist, every man needs to own exactly one donkey.

[8] The 'filter' terminology comes from Kartttunen's [1973] classic discussion of presupposition projection.

donkey' has a classical existential semantics, and so while it may filter existence presuppositions in the nuclear scope, it cannot filter uniqueness presuppositions.

One solution suggested by Davies [1981] and Neale [1990] is to treat the descriptions in (3) and (4) as 'numberless' descriptions (optionally plural rather than singular). We can easily see, though, that many of the readings of donkey anaphora are not, in fact, equivalent to what we get with a plural description. Compare, for instance, these two sentences:

(6) Every man who owns a donkey and pays tax on it avoided arrest.

(7) Every donkey-owner who pays tax on the donkeys he owns avoided arrested.

For (6) to be true everyone who pays tax on at least one donkey he owns needs to avoid arrest, while for (7) to be true it seems we only need every donkey owner who pays tax on *every* donkey he owns to avoid arrest.[9]

A more promising approach in the e-type literature is to treat the uniqueness implications of donkey anaphora as relative to situations (as in Heim [1990] following Berman [1991]), or as relative to events (as in Ludlow [1994]). The gist of the idea is most natural in examples with adverbs of quantification such as (2), which could be rephrased as follows in situation-speak (following Heim):[10]

(8) Every minimal situation s in which a man owns a donkey, can be extended into a larger situation s' in which the man in s' pays taxes on the donkey he owns in s'.

Heim, using the situation-semantic framework of Kratzer [1989], sketches a semantics which yields meanings like (8) for sentences with donkey anaphora. For the rest of this paper we will focus our attention on this situational e-type approach as it is the best developed version of the view [Elbourne, 2005, 2013, Büring, 2004].[11]

3 SITUATION E-TYPE SEMANTICS

We'll start by giving a more detailed sketch of how a situation semantics deals with the core data of donkey anaphora. We begin with our baseline semantic assumptions. We take as primitive a set of situations S with respect to which sentences are true (1) or false (0) (or in cases of presupposition failure, undefined, #). We will assume that there is a partial order, $\leq$, over situations, and that every

[9] Other powerful arguments against the numberless view can be found in the literature [Kanazawa, 2001, e.g.,].

[10] References to Heim can be a bit confusing since Heim both developed one of the original dynamic system [1982] *and* developed a prominent version of the e-type theory that we discuss here [1990]. For this reason we adopt the convention that unless we explicitly refer to Heim's work from the 1980s when we discuss her views we are discussing her version of the e-type theory.

[11] We see no reason why the basic points we make would not also apply to the event-based approach advocated by Ludlow [1994] and Schein [1993].

set of situations contains a minimal element with respect to $\leq$. [12] We assume sentences are uttered with respect to some situation, which we call the *topic situation*, which can be the entire world or some part of it depending on context. Semantic denotations are relativized to a situation as well as an assignment function, as in our entry for the definite description here:[13]

$$[\![\text{the } (\varphi, \psi)]\!]^{f,s} = \begin{cases} \# \text{ if there is not a unique } o \text{ such that } [\![\varphi]\!]^{f,s}(o) = 1 \\ 1 \text{ if for every } o, \text{ if } [\![\varphi]\!]^{f,s}(o) = 1 \text{ then } [\![\psi]\!]^{f,s}(o) = 1 \\ 0 \text{ otherwise} \end{cases} \quad \text{(a)}$$

This entry treats 'the' as a generalized quantifier that takes two arguments of type $\langle e, t \rangle$ (a basically equivalent approach in which it is instead treated as of type e could be pursued without affecting the argument we pursue here). The relevant point is that in (a) we evaluate the restrictor φ with respect to the situation of evaluation, s, so uniqueness is relative to a situation, not a world. The idea is that this will render unwanted uniqueness presuppositions innocuous: there will still be a presupposition that there is a unique φ-thing, but relative to a situation which may be arbitrarily small, making the presupposition, in turn, arbitrarily weak.

Since we will mainly deal with embeddings under generalized quantifiers we will give semantic values for some complex predicates, putting aside the compositional details of how they are formed.

$$[\![\text{man who owns a donkey}]\!]^{f,s} = \lambda x.x \text{ is a man and owns a donkey in } s \quad \text{(b)}$$

Recall that pronouns get spelled out as definite descriptions (recovering the content in some way from context). We will give the semantics of complex

[12] The literature on situations tends to take them as primitive: they are parts of worlds. For our purposes, if you want a specific model of them, something along the lines of a set of object together with a partial extension of the predicates in the language could do (as in Barwise and Perry 1983); alternatively, they could be sets of possible worlds, as in Humberstone 1981.

[13] In the interest of economy when we list cases with the { notation each subsequent case includes in it the proviso that all the previous cases do not hold. So for example:

$$f(x) = \begin{cases} 1 \text{ if } x \text{ is odd} \\ 2 \text{ if } x \text{ is a multiple of 3} \\ 0 \text{ if } 1 = 1 \end{cases}$$

is equivalent to

$$f(x) = \begin{cases} 1 \text{ if } x \text{ is odd} \\ 2 \text{ if } x \text{ is a even multiple of 3} \\ 0 \text{ otherwise} \end{cases}$$

We will tend to use 'otherwise' rather than '1=1', however.

predicates with pronouns with their contextual material inserted as follows:[14]

$$[\![\text{pays taxes on it}]\!]^{f,s} = \lambda x \begin{cases} \#\text{ if there is no unique object } o \\ \quad \text{in } s \text{ that is a donkey owned by } x \\ 1 \text{ if } x \text{ pays taxes on every donkey he owns} \\ 0 \text{ otherwise} \end{cases} \tag{c}$$

This is not the only meaning 'pays taxes on it' could have but rather the meaning that situation e-type theories would give it in the context (1).

Consider now this standard entry for the generalized quantifier 'every':

$$[\![\text{every}(\varphi,\psi)]\!]^{f,s} = \begin{cases} 1 \text{ if } \{o : [\![\varphi]\!]^{f,s}(o) = 1\} \subseteq \{o : [\![\psi]\!]^{f,s}(o) = 1\} \\ 0 \text{ otherwise} \end{cases} \tag{d}$$

Entry (d) in combination with our entries above for 'man who owns a donkey' and 'pays taxes on it' yields the result that 'every man who owns a donkey pays taxes on it', (1), when evaluated in a situation s is false if some man owns more than one donkey in s.[15] This is intuitively wrong. For (1) can be true in such situations: this intuition is especially clear if every man who owns more than one donkey pays taxes on all of them.[16]

To avoid the unwelcome uniqueness implications, Heim suggests giving a more complex definition of 'every' in which there is not just quantification over individuals but also over situations:

$$[\![\text{every}(\varphi,\psi)]\!]^{f,s} = \begin{cases} 1 \text{ if for every object } o \text{ and for every minimal} \\ \quad \text{situation } m \leq s \text{ such that } [\![\varphi]\!]^{f,m}(o) = 1, \\ \quad \text{there is a situation } m',\ m \leq m' \leq s, \\ \quad \text{such that } [\![\psi]\!]^{f,m'}(o) = 1 \\ 0 \text{ otherwise} \end{cases} \tag{e}$$

Making reasonable assumptions about the structure of situations and which ones are minimal, with this entry for 'every', (1) is true in a situation s iff every man in s who owns one or more donkeys in s pays taxes on every donkey he owns. These are widely considered to be correct truth-conditions for at least one reading of the sentence.

Effectively what has happened is that by supplementing the objectual quan-

[14] The details of how we get a description from context will be mainly irrelevant to our discussion. One leading account is Elbourne's NP-deletion account which we will discuss below in section 8. On this account the description in this entry would just be 'the donkey'.

[15] As we discuss later, we should really treat the presupposition projection properties of 'every' in a more nuanced way to predict that the sentences are undefined in such cases.

[16] Whether that is also required for the truth of (1) in such situations is controversial; this is the issue of strong versus weak readings of donkey sentences.

tification associated with the quantifier 'every' with situational quantification, we have removed the harmful uniqueness assumption that marred our previous definition of 'every'. This move is also used by Elbourne [2005] and Büring [2004] in their development of situation semantics for donkey anaphora, so it seems an essential element in the overall situational e-type strategy.

We need to examine another trick needed to make the situation semantics empirically adequate. So far we have not used the assignment function f in our semantics.[17] We now will introduce a system of situational indices that quantifiers and definite descriptions interact with.[18]

We are going to assume that there are indices for situation variables. A definite description can be indexed to a situation variable and the object it picks out is determined relative to the situation indexed. Here is the semantic entry for such an indexed definite description.

$$[\![\text{the}_i(\varphi,\psi)]\!]^{f,s} = \begin{cases} \#\text{ if is no unique object } o \\ \quad \text{such that } [\![\varphi]\!]^{f,f(i)}(o) = 1 \\ 1 \text{ if for every } o\text{, if } [\![\varphi]\!]^{f,f(i)}(o) = 1 \\ \quad \text{then } [\![\psi]\!]^{f,s}(o) = 1 \\ 0 \text{ otherwise} \end{cases} \tag{f}$$

We then have variants of donkey pronouns that contain such indices, and which spell out in the end as indexed descriptions as follows:

$$[\![\text{pays taxes on it}_i]\!]^{f,s} = \lambda x. \begin{cases} \#\text{ if there is no unique object } o \\ \quad \text{that is a donkey owned by } x \text{ in } f(i) \\ 1 \text{ if } x \text{ pays taxes in } s \text{ on the donkey} \\ \quad \text{owned by } x \text{ in } f(i) \\ 0 \text{ otherwise} \end{cases} \tag{g}$$

To make this index sensitivity of particular use to us we will give a variant of 'every', which ensures that the matrix clause is evaluated with respect to a

[17] Presumably we will need some kind of λ-abstraction to deal with quantificational structures as in Heim and Kratzer [1998], but we have put aside such compositional details here.

[18] In allowing descriptions and pronouns to have situational indices we follow Heim [1990] and Büring [2004]. Elbourne [2005] claims they are unnecessary, but given the arguments in Heim and Büring and the later use of them by Elbourne himself [2013], it seems their need is generally accepted.

shifted value of a special index r as follows:[19]

$$[\![\text{every}(\varphi,\psi)]\!]^{f,s} = \begin{cases} 1 \text{ if for every object } o \text{ and for every minimal} \\ \quad \text{situation } m \leq s \text{ such that } [\![\varphi]\!]^{f,m}(o), \\ \quad \text{there is a situation } m',\ m \leq m' \leq s \\ \quad \text{such that } [\![\psi]\!]^{f_{r\to m},m'}(o) \\ 0 \text{ otherwise} \end{cases} \tag{h}$$

Here are two motivations for this indexing:[20]

i) Consider first Heim's famous sage-plant sentences, repeated here:

(5) Everyone who bought a sage plant bought eight others along with it.

If we do not use the indexing trick here, i.e. if we do not index 'it' with a situation index shifted by the quantificational structure, then we will not be able to get a true reading of the sentence. This is because in any situation in which a man buys a sage plant to satisfy the matrix predicate he will have to buy eight other sage plants, but then the uniqueness condition of 'it', which must spell out to 'the sage plant he bought' will fail to be satisfied. On the other hand, if we evaluate 'the sage plant he bought' with respect to minimal situation in which a man bought one sage plant (which we can do by indexing it to r), the uniqueness condition is automatically satisfied.[21]

In short: we want the uniqueness of 'it' to be evaluated relative to minimal situations in which a man buys a sage plant (a reading which indexing makes possible), rather than relative to the situation in which he buys nine sage plants.

ii) Another potential reason for having situational indices is to handle examples like the following, pointed out by Büring [2004].

(9) Every man loves the woman.

If we just process the truth conditions we get using the 'every' of (e) above we would get this to be true if every situation in which there is man can be

[19] Our indexing system is rather crude and simplified. Büring [2004] gives a more sophisticated (and compositional) one.

[20] For more, see Büring [2004].

[21] It's worth pausing here to note the unintuitive notion of situation necessary: every situation of buying four sage plants has four sub-situations on this view each of which is a situation of buying just one sage plant. It is this sort of reason that we suggest in footnote 12 modeling situations by a set of objects and a partial extension of predicates.

extended to one in which there is some woman that he loves. This makes it too easy for (9) to be true. (I.e., it seems to be predicted that (9) should be equivalent to 'Every man loves a woman'; but it is not.) Büring uses this to motivate indexing by suggesting that the only possible readings of (9) are ones where the pronoun is indexed to the situations introduced by the quantifier, as in (10), or else the one where it is simply indexed to some contextually relevant situation.

(10) Every (man, loves the$_r$ woman)

If we have this stipulation (which is not hard to state on Büring's system, though it requires abandoning our index-free definition of 'the', in (a), then we explain why this sentence seems to require there to be just one woman (in the world or in some relevant topic situation). In the next section we will revisit this argument in the light of more general considerations about presuppositions.

The last part of our sketch of an e-type situation semantics is a semantics for conjunction. This semantics goes beyond the received word on e-type situation semantics, which is generally silent on the treatment of conjunction. We will assume that situation semantics contains a classical treatment of conjuction: for φ and ψ to be true in a situation φ has to be true in it as well as ψ:[22]

$$[\![\varphi \text{ and } \psi]\!]^{f,s} = \begin{cases} 1 \text{ if } [\![\varphi]\!]^{f,s} = [\![\psi]\!]^{f,s} = 1 \\ 0 \text{ if } [\![\varphi]\!]^{f,s} = 0 \text{ or } [\![\psi]\!]^{f,s} = 0 \\ \# \text{ otherwise} \end{cases} \quad \text{(i)}$$

Although, again, there is no discussion of conjunction in the situational e-type literature, this is presumably because a standard entry like the one above is assumed.[23] We will ultimately argue, however, that this (near) classical entry does not work, and that, in fact, an adequate situational e-type view needs to provide a non-classical conjunction just as dynamic semantic does.

4 PRESUPPOSITION PROJECTION

In this section we will add to our sketch of situation semantics a better treatment of the existence and uniqueness presuppositions of definite descriptions and donkey anaphora. There is not, to our knowledge, any developed treatment of presuppositions in quantified donkey sentences such as (1) in the literature on

[22] The definedness conditions here are the strong Kleene conditions (but their use is not strictly relevant to the points we make below).

[23] It is striking that even the book-length treatments of situation semantics do not include lexical entries for most of the logical vocabulary such as conjunction and negation. In this respect the explicit situation semantics in the literature are much less developed than their dynamic rivals.

situation semantics.[24] This is an unfortunate state of affairs as it makes a direct comparison between dynamic semantics and situation semantics difficult, as the latter simply does not cover the same ground as the former. In this section we will try to rectify this situation by laying out what a theory of presupposition projection in a situational e-type theory would need to look like.

It is worth noting that the behavior of presuppositions that are triggered in the context of quantificational sentences (such as a definite description under a quantifier) is one of the most vexed topics in the presupposition literature.[25] Consider the following two sentences:

(11) a. Every student thinks his paper is brilliant.
b. Not every student thinks his paper is brilliant.

In both cases there is a presupposition trigger: the possessive description 'his paper' triggers an existence presupposition.[26] The critical question is what the presupposition of the entire sentence is. The standard hypothesis, following Heim [1983], is that (11-a), and thus also (11-b), gives rise to a universal presupposition: that every student has a paper. The fact that both sentences in (11) seem to communicate that each student has a paper supports this hypothesis in this case. By contrast, Beaver [1994, 2001] gives a semantics according to which both these sentences have only an existential presupposition that at least one of the students has a paper; this is *prima facie* at odds with judgments about sentences like (11-b).[27]

Since we have both quantification over situations and quantification over objects in our situation theoretic entry for 'every' we need to describe the projection behavior with respect to both of these. Let's first come up with a natural *universal* projection constraints. An extension of Heim's universal presupposition

[24] Heim [1990] explicitly puts the question aside. Elbourne [2013] devotes a chapter to presupposition projection, but the semantic system in the book does not make any predictions about the presuppositions of quantified donkey sentences, because the lexical entries for quantifiers such as 'every' (p. 26) do not specify what happens when the predicates they apply to are undefined.

[25] See, e.g. Heim [1983], Beaver [1994], Schlenker [2006], Chemla [2009], Fox [2012].

[26] It's worth mentioning that while possessive descriptions trigger existence presuppositions, they do not seem to trigger the same kind of uniqueness presuppositions that definite descriptions do.

[27] Of course, Beaver, like anyone else, takes the (11-a) to *entail* that every student has a paper.

strategy for donkey anaphora would be as follows:

$$[\![\text{every}(\varphi,\psi)]\!]^{f,s} = \begin{cases} \# \text{ unless for every object } o,\ [\![\varphi]\!]^{f,s}(o) \neq \# \\ \quad \text{and for every object } o, \text{ for every minimal} \\ \quad m \leq s \text{ such that } [\![\varphi]\!]^{f,m}(o) = 1,\ [\![\psi]\!]^{f_{r\to m},s}(o) \neq \# \\ 1 \text{ if for every object } o \text{ and for every minimal} \\ \quad \text{situation } m \leq s \text{ such that } [\![\varphi]\!]^{f,m}(o) = 1, \\ \quad \text{there is a situation } m',\ m \leq m' \leq s \\ \quad \text{such that } [\![\psi]\!]^{f_{r\to m},m'}(o) = 1 \\ 0 \text{ otherwise} \end{cases} \tag{j}$$

We will now give some considerations in favor of an entry along these lines.

To begin with (j) explains the infelicity of (9), repeated here, in a straightforward way.

(9) Every man loves the woman.

Let us assume that the semantic entry for 'loves the woman', is as follows:

$$[\![\text{loves the woman}]\!]^{f,s} = \lambda x.\begin{cases} \# \text{ if there is no unique woman in } s \\ 1 \text{ if } x \text{ loves a woman in } s \\ 0 \text{ otherwise} \end{cases} \tag{k}$$

Then, given (j), we can see that the entire sentence (9) is undefined when there is more than one woman in the topic situation. We cannot avoid this undefinedness by trying to index 'the woman' with the quantifier 'every' since the restrictor situations (all man-situations) do not include any women; the only way to avoid undefinedness would be by indexing 'the woman' to the topic situation, in which case (9) will be defined just in case the topic situation includes a unique woman, matching intuitions. Büring's example (9) thus either triggers the presupposition that there is a unique woman in the topic situation, or else the obviously false presupposition that in every situation in which there is a man there is a unique woman. This explains the intuitions about Büring's case, and in a simpler way than Büring does, as it requires no stipulations about how definite descriptions can be indexed.

We can now sum up what predictions we get with the definition of 'every' in (j) for presuppositions of definite descriptions in the nuclear scope. There are two salient possibilities: if we index the definite in the nuclear scope to r then for every object satisfying the restrictor the presupposition of the definite must be satisfied in every minimal witness situation of it. If the definite description is unindexed, as in (a), or is indexed to the topic situation, then the presuppositions of the definite need to be satisfied in the topic situation.

This account rightly predicts, for instance, that (12) has no presupposition, since the presupposition of 'the$_r$ woman' will always be satisfied, since every minimal restrictor situation has exactly one woman in it:

(12) Every man who met a woman liked the$_r$ woman he met.

But if we don't have a restrictor to provide a minimal witness that satisfies uniqueness and existence, we get presuppositions as in (13) that need to be satisifed in the topic situation:[28]

(13) Every man liked the woman he met.

That (13) triggers not just an existence presupposition (that every man met at least one woman), but also a uniqueness one (that every man met only one woman), can be seen by the infelicity of the following example:[29]

(14) Every man met one or two women. ?Every man liked the woman he met.

By contrast the entries for 'every' in (e) and (h) predict that (13) carries no presuppositions and is true if every man met some woman and liked her in the topic situation.[30]

We could also explain some of this data by keeping Büring's hypotheses that definite descriptions must be indexed, as in (f) rather than (a), and that, in the matrix of a generalized quantifier, descriptions cannot be indexed to the situation of evaluation. This explanation, however, fails to explain why the examples such

[28] That these are presuppositions rather than entailments can be seen by the fact that when we turn (13) into a question we still get the presupposition that every man met just one woman:

(i) Did every man like the woman he met?

[29] It is worth noting that Elbourne [2013, pp. 59–64] gives a different explanation of the badness of Büring examples, suggesting that the presupposition might be impossible to accommodate, following Kripke's observations about accommodation with 'too'. However, it is easy to show that this not the (only) problem with Büring example. Here one need accommodate any new information to make the example work if we have a our old definition of 'every', that of (e). But the examples is still infelicitous, so Elbourne's solution does not work.

[30] We can also give a Beaver-like [2001] existential presupposition to 'every' as in:

$$[\![\text{every}(\varphi,\psi)]\!]^{f,s} = \begin{cases} \# \text{ if for every object } o,\ [\![\varphi]\!]^{f,s}(o) = \# \\ \quad \text{or for every object } o, \text{ for every minimal} \\ \quad m \leq s \text{ such that } [\![\varphi]\!]^{f,m}(o) = 1,\ [\![\psi]\!]^{f_{r\to m},s}(o) = \# \\ 1 \text{ if for every object } o \text{ and for every minimal} \\ \quad \text{situation } m \leq s \text{ such that } [\![\varphi]\!]^{f,m}(o) = 1, \\ \quad \text{there is a situation } m',\ m \leq m' \leq s \\ \quad \text{such that } [\![\psi]\!]^{f_{r\to m},m'}(o) = 1 \\ 0 \text{ otherwise} \end{cases}$$

This would give (13) the very weak presupposition that some man met some woman, and so also fails to explain the data.

as (13) trigger a *presupposition* that persists when they form part of a question or are embedded under negative operators like 'I doubt'.[31]

Before continuing though should put aside the tempting idea that the badness of (14) should instead be explained by a competition between plural and singular definite descriptions. This is because the different forms actually differ in truth-conditions on the semantics in play. Consider the plural variation on (14) below:

(15) Every man met one or two women. Every man liked the women he met.

While (15) is felicitous and so does not trigger a uniqueness implication, for it to be true it requires that every man love all the women he met.[32] But were (14) to be felicitous its truth-conditions on the relevant semantics would be existential: every man would only have to love one woman he met for it to be true.

5 PROBLEMS WITH CONJUNCTION

We argued in the last section that it was important that definite descriptions in the matrix of 'every' triggered strong presuppositions. We will argue here that, while the presuppositions posited in the last sections are compatible with most of the data we have looked at so far, they start to cause trouble when we consider donkey anaphora across conjunctions.

First, let us see how presuppositions work in an example of standard donkey anaphora. Consider an example like (1) repeated here:

(1) Every man who owns a donkey pays taxes on it.

Using our clause entry (j) for 'every' discussed in the last section along with a donkey pronoun indexed to r, we ensure that the sentence as a whole yields no presupposition. This is because when we evaluate the restrictor we have shifted the assignment of r to provide a minimal situation with exactly one donkey.

However, now consider the predictions our account makes about this example:

(16) Every man met a woman and liked [her/the woman he met].

Working through our semantics we can see that the uniqueness presupposition triggered by 'her' projects out of the sentence. This is because 'met a woman and liked the woman he met' is undefined relative to s if the object it applies to is a man who met more than one woman in s. So (21) is only defined if relative to the topic situation every man met exactly one woman.[33]

[31] In any case if we maintain the Büring explanation of the data nothing in our discussion will change very much.

[32] More or less, plural definites actually have rather complex truth conditions, see Križ [2015] for a recent discussion.

[33] Actually it is defined and false on our definition if no man met a woman, but this does not affect our discussion.

This means that we predict that (16) has the same uniqueness predictions as (13), repeated here:

(13) Every man liked the woman he met.

This is a bad prediction. While (13) presupposes that every man just met one woman, (16) does not. One way to see this is to contrast these two cases:

(17) a. Every man met one or two woman, and liked at least one of them. So every man met a woman and liked [her/the woman he met].
b. Every man met one or two woman, and liked at least one of them. ?? So every man liked the woman he met.

The best explanation of this contrast is that (13) has a uniqueness presupposition that (16) lacks. This obviously provides an explanation; an argument that it is the correct explanation comes from the fact that we observe a parallal contrast when (13) is embedded under negation:

(18) a. Every man met one or two woman, and some men disliked all the women he met. So not every man met a woman and liked [her/the woman he met].
b. Every man met one or two woman, and some men disliked all the women he met. ?? So not every man liked the woman he met.

This is, of course, immediately explained if what accounts for the infelicity of (17-b) and (18-b) is a uniqueness presupposition, which will project through negation. We get similar contrasts when we embed (13) in the antecedents of conditionals, attitude contexts, and questions; to put just one more example on the table, note the contrast in (19):

(19) a. (i) Every man met one or two woman. (ii) Well, did every man meet a woman and like [her/the woman he met]?
b. (ii) Every man met one or two woman. (ii) ? Well, did every man like the woman he met?

We also argue that similar observation can be made about pronouns/definite descriptions in the restrictor:

(20) [Situation: all farmers are men, every farmer is a donkey-owner] Every farmer who cares for the donkey he owns is happy.

(21) Every farmer who owns a donkey and cares for [it/the donkey] is happy.

Again, while (20) has a clear uniqueness implication, (21) does not.

What we have argued in this section is that the tools needed to correctly predict presuppositions for definite descriptions under quantifiers overgenerate

presuppositions on the situational e-type account.

6 DYNAMIC ACCOUNT

The standard dynamic account of Heim [1982] does not have any trouble with the examples discussed in the previous section. For in dynamic semantics pronouns and definite descriptions can be bound across conjunctions and, thus bound, they do not put any conditions on the common ground (i.e. they do not lead to presuppositions). Indeed binding in such conjunctive configurations as 'A man$_i$ walked in and he$_i$ bought a drink' is a hallmark of dynamic semantics. For example, in dynamic semantics the pronoun in the sentence (16) does not lead to any presuppositions as it is bound by the indefinite (the same applies if we replace the pronoun by a definite description). By contrast, an example like (13) requires a context to have a discourse referent for the definite description 'the woman he met'.

Without going too far into details it is worth gesturing to how a dynamic story might explain the uniqueness presuppositions we have witnessed. Heim [1982, ch. 3] proposes that when there are definite descriptions that are not bound to an indefinite prior in the discourse they need to treated by a process of accommodation. She notes that the process might require some non-trivial constraints. Later Roberts [2003] proposed that unaccommodated definite descriptions give rise to uniqueness implications. Such uniqueness implications arising when definite descriptions are not bound by previous discourse referents seem to be exactly what we observe in the data we discussed above.

We are thus optimistic that the dynamic account can succeed where the e-type account flounders.

7 PSUEDO-DYNAMIC CONJUNCTION

So far we have seen that e-type theories along the lines of Heim [1990] do not in fact avoid the problem of giving rise to unwelcome uniqueness implications. Rather once we move beyond the simplest donkey sentences into those with conjunctions we again predict unobserved uniqueness implications. Moreover, we cannot simply stipulate these away because when one uses definite descriptions that are not dynamically bound the uniqueness implications disappear. Thus, we seem to have a powerful argument for the dynamic view of binding across conjunctions.

Of course, it is worth noting that a die-hard e-type theorist could respond to our problems by revising their definition of conjunction. Like a dynamic conjunction this conjunction would allow the interpretation of the second conjunct to be affected by the first conjunct in a non-pragmatic way. The way to do this is to give a treatment of 'φ and ψ' according to which when we evaluate ψ we have an index that picks out the minimal situation in which φ is true. Here is a

definition of conjunction which works this way.

$$[\![\varphi \text{ and } \psi]\!]^{f,s} = \begin{cases} 1 \text{ if } [\![\varphi]\!]^{f,s} = [\![\psi]\!]^{f[p,\varphi,s],s} = 1 \\ 0 \text{ if } [\![\varphi]\!]^{f,s} = 0 \text{ or } [\![\psi]\!]^{f[p,\varphi,s],s} = 0 \\ \# \text{ otherwise} \end{cases} \quad \text{(l)}$$

To complete the definition we define $f[i,\varphi,s]$ as follows:

$$f[i,\varphi,s] = f_{i \rightarrow \text{minimal situation } m \leq s \text{ such that } [\![\varphi]\!]^{f,m} = 1}$$

In (l), p is a special variable that always picks out the minimal witness situation of the previous conjunct (just like r picks out minimal witness of the restrictor in (h)). Using this conjunction and along with an indexed 'the' as in (f) we can simply index a definite description in the second conjunct to a minimal witness situation making the first conjunct true. If we do this, though, we seem to be simply recreating the dynamic treatment of the logical connectives in a situation-theoretic framework.[34]

An important dialectical point to note is that the dynamic conjunction in (l) is *not* motivated by independent properties of presupposition projection, beyond the behavior of definites and pronouns. If situation semanticists could argue that we need something like (l) for reasons quite independent of definites and pronouns, this might soften the blow of the present point: the idea would be that, once we fix up our connectives to deal with the properties of presupposition projection in general, the behavior of definites and pronouns follows. This would still bring situation semantics closer to dynamic semantics than it has ever explicitly been presented as being. But the entry for conjunction would at least not be tailor-made to deal with the data we've presented here.

This approach, however, won't work. The behavior of presupposition projection in general might merit adopting a semantics for 'and' like the following:

$$[\![\varphi \text{ and } \psi]\!]^{f,s} = \begin{cases} 1 \text{ if } [\![\varphi]\!]^{f,s} = [\![\psi]\!]^{f,s} = 1 \\ 0 \text{ if } [\![\varphi]\!]^{f,s} = 0 \text{ or } [\![\varphi]\!]^{f,s} = 1 \wedge [\![\psi]\!]^{f,s} = 0 \\ \# \text{ otherwise} \end{cases} \quad \text{(m)}$$

Given this semantics, a conjunction is true if both conjuncts are, false if the first conjunct is false or the first conjunct is true and the second false, and undefined if the first conjunct is undefined or the first conjunct is true and the second conjunct is undefined. This conjunction is essentially the middle Kleene conjunction, and is all that can really be motivated on the behavior of presupposition projection in

[34] Our point here is related to the argument in Dekker [1997]. Dekker, who looks only at examples with adverbs of quantification, argues that situation semantics can only reproduce the success of dynamic semantics by mimicking it very closely. He also argue that such mimicking makes the system unappealing for fans of situations.

general.[35] It does not help in the least with our problems. Nor does the dynamic conjunction in (l) help with projection beyond that of definites. If we want to account for uniqueness presuppositions in situation semantics, we need the much more thoroughly, and *ad hoc*, dynamic conjunction above (or something like it), which must be motivated on the basis of the behavior of pronouns and definites, not general considerations about presupposition projection.

8 COMPARISON WITH DYNAMIC SEMANTICS

The lesson of the paper so far is a conditional one. *If* situation e-type semantics is to capture the data we have presented here, it must adopt a dynamic 'and', one very much like the 'and' advocated from the start in dynamic semantics, but never to our knowledge advocated in situation semantics. Some may take this to be the end of the line for situation semantics. After all, the whole point of situation semantics was to capture the dynamics of anaphora without encoding those dynamics semantically: the idea was that we could account for anaphora in a more parsimonious, and fully classical, semantic framework than dynamic semantics offers.

Another reason we may think that present considerations are fatal for situation semantics is that it may look as though the dynamic situation semantics we have given here just *is* dynamic semantics. If we have shown that the only viable version of situation semantics is so distended that it is equivalent to dynamic semantics, then there would indeed be nothing more to say in its favor.

But both these reactions are too quick. The present considerations do indeed undermine some potential motivations for the situation framework. But a dynamic situation semantics like the one we have suggested here cannot be ruled out on the basis of this dialectical fact. Moreover, this dynamic situation semantics is very close to dynamic semantics, but is *not* exactly equivalent to dynamic semantics. It differs from dynamic semantics in two important ways: first, situation semantics uses a licensing principle of some kind (like NP-deletion) to spell out pronouns, instead of spelling them out as indexed variables as in dynamic semantics. Second, in situation semantics, definites presuppose uniqueness; apparent counterexamples are explained away by using suitably small situations. By contrast, in dynamic semantics, definites requires familiarity, not uniqueness. In this section, we will discuss a few areas where these differences matter, pointing to some problems even for dynamic situation e-type theories which dynamic semantics avoids.

8.1 THE FORMAL LINK

The first difference we'll focus on between dynamic situation e-type semantics (henceforth just 'situation semantics', but we have in mind in particular the

[35] See Beaver and Krahmer [2001], Krahmer [1998] for discussion of this style of trivalent semantics for connectives.

dynamic variant developed above) and dynamic semantics is in how pronouns and (in)definites are spelled out. In dynamic semantics, of course, these are all just variables (in the case of definites, variables together with certain definedness conditions). By contrast, in situation semantics, pronouns are spelled out as definite descriptions, which have classical uniqueness presuppositions which must be satisfied in minimal situations. Each of these approaches has more flexibility in some respects than the other. We will argue that the flexibility of situation semantics leads to problematic overgeneration.

It's well known that some licensing requirement on how we spell out pronouns in situation semantics is needed (this is known in the literature as 'the problem of the formal link'). The motivation for this is minimal pairs like Elbourne [2005]'s (22):

(22) a. Someone who has a guitar should bring it.
b. ??Someone who is a guitarist should bring it.

According to situation semantics, we interpret the 'it' in (22-a) as 'the guitar', getting us the intended interpretation. The puzzle is why we can't also spell out the 'it' in (22-b) as 'the guitar', rendering them both equivalent (and equally felicitous). Dynamic semantics, of course, has no parallel problem, since standard dynamic systems immediately predict the contrast between (22-a) and (22-b): only the former contains an indefinite to license the use of the pronoun 'it'.

There are different proposed solutions to the problem of the formal link. We cannot address all of them here, nor show that there is no possible solution to this problem. But we will argue that two popular solutions to this problem do not work at all; we'll discuss in particular Elbourne's attractively simple NP-deletion proposal, and a slightly more complex proposal of Heim. On Elbourne's theory, 'it' is always interpreted as 'The NP', where 'NP' is a noun phrase that, in the absence of sufficient deictic contextual information, *must have a linguistic antecedent*—i.e. that is copied from preceding linguistic material. This accounts for the contrast between (22-a) and (22-b): in the former case, 'it' can be spelled out as 'the guitar', since 'the guitar' appears in the preceding linguistic material; not so in the latter case. And what is nice about this approach is that NP-deletion is, of course, already an attested phenomenon in natural language, as in (23):

(23) I have a guitar, and John has one ~~[guitar]~~ too.

So Elbourne's account reduces the problem of the formal link to an independently attested phenomenon, making it an admirably simple and testable account.

But an NP-deletion account of the formal link does not seem empirically adequate to us. Consider Partee's famous marble example:

(24) a. I dropped ten marbles and found all of them, except for one. It is probably under the sofa.

b. I dropped ten marbles and found only nine of them. ?? It is probably under the sofa.

According to an NP-deletion story, (24-a) will be acceptable because the 'it' will be spelled out as 'the marble', picking up 'marble' from the previous sentence. But what can account for the infelicity of (24-b)? The previous sentence is truth-conditionally equivalent to the first sentence in (24-a). And, crucially (unlike in (22)), an appropriate antecedent NP *is* accessible in (24-b), namely, once more, 'marble'. So why can't we interpret the 'it' in (24-b) as 'the marble', rendering it felicitous, and equivalent to (24-a)?

One possible response here is that there is something independently wrong with (24-b), even given the appropriate spell-out. An argument for this comes from the observation that (25) still sounds quite weird:

(25) I dropped ten marbles and found only nine of them. ? The marble is probably under the sofa.

But the question is *why* this is so. One should not be tempted by the thought that situation semantics can account for the contrast in (24) just because there is a parallel contrast between (24-a) and (25): again, *both* situation semantics and dynamic semantics assimilate pronouns and definites; but dynamic semantics has an account of these contrasts,[36] while the situation semantics, together with an NP-deletion account of the formal link, does not seem to be able to.

We can easily multiply cases like this, and further refine our argument that something goes wrong with the NP-link story. Consider (26):

(26) a. John doesn't have a baby. But Theo has a baby, so Theo brought it to John's house to show everyone.
b. John doesn't have a baby. But Theo is a new father, so ?? Theo brought it to John's house to show everyone.

The issue for the NP-deletion story is that the first sentence in each of (26-a) and (26-b) contains the noun 'baby'. In (26-a) (according to that story) we use 'baby' from the first part of the second sentence as the anteceddent for 'it', giving us the intended reading of (26-a). So why, in (26-b), can't we use the 'baby' from the *first* sentence as a linguistic antecedent which will allow us to spell out the 'it' in the second sentence as 'the baby'? I.e. why can't we interpret (26-b) so it is equivalent to (27), which in turn should be equivalent to (28)?

(27) John doesn't have a baby. ? But Theo is a new father, so Theo brought the baby to John's house to show everyone.

[36]The basic idea is simple: 'except for one' introduces a discourse referent which can be picked up by the subsequent 'it' or definite. To spell this out, we would of course need to say more about the semantics of 'except'.

(28) John doesn't have a baby. But Theo has a baby, so Theo brought the baby to John's house to show everyone.

From the point of view of dynamic semantics, the contrast between (26-a) and (26-b) is, of course, straightforward to explain. Dynamic semantics can likewise explain why (28) is completely acceptable, and why (27) is marginally better than (26-b) (while we have to accommodate a definite ('the baby'), there is enough descriptive material in the definite that we can do so with relative ease; whereas in (26-b) we have to accommodate a pronoun ('it') but we lack any descriptive material to help us do that.). By contrast, it looks like the NP-deletion story doesn't have much to say about how to distinguish these sentences: on that story, there should be a prominent parse of (26-b) on which it is equivalent to (26-a), (27), and (28).

A possible response on behalf of an NP-deletion story is that 'a baby' in the first sentence of (26-b) is just too far away from the 'it' in the last sentence of (26-b) to license NP-deletion. It is obviously true that, in general, the linguistic anaphor for NP-deletion needs to be relatively close to the deleted material. But in this case, such a response won't work, because the NP-deletion theory has to say that 'a baby' *can* license NP-deletion across a distance like this in some cases, as the minimal variant in (29) shows:

(29) John has a baby. And Theo loves babies, so John brought it to Theo's house to show him.

Given an NP-deletion account of the formal link, we can only account for the felicity of (29) if the 'it' in the second sentence is spelled out as 'the baby'. But then the 'it' gets its linguistic anaphor from across exactly the same distance as it would have to in (26-b), meaning that we cannot rule out the relevant parse in (26-b) on the basis of distance alone.

A different possible response would be that the problem is not the distance *per se*, but the fact that the antecedent in our key (26-b) is in particular embedded under a negation. If NP-deletion were generally impossible when the antecedent is under a negation, this would give Elbourne a straightforward response (it would leave open the question why NP-deletion is impossible in such an environment, but this would be a question for everyone). The problem is that NP-deletion is *not* generally impossible when the antecedent is under negation. Consider (30):

(30) John doesn't have a baby. But Theo has one ~~[baby]~~.

A final response would combine the last two, claiming that NP-deletion is not possible in general when the antecedent is under a negation *and* a sentence intervenes. But, once more, we can show that this is false with examples like (31):

(31) John doesn't have a baby. But Theo is totally overwhelmed, because he does have one ~~[baby]~~.

Here NP-deletion clearly *is* possible, with the antecedent under a negation and separated from the deleted material by an intervening sentence. So the present response is not promising. We think that examples like this show that an NP-deletion story doesn't work.

We also think that the formal link story spelled out in Heim 1990, based on stories in Evans 1977a, Parsons 1978, won't work either. Heim's story *can* account for the infelicity of (26-b). It requires the material copied from an antecedent NP to be of the form ⌜NP S⌝, so that (26-b) would be spelled out as (32) or (33), both of which are absurd on truth-conditional grounds:

(32) John doesn't have a baby. But Theo is a new father, so ?? Theo brought *the baby John has* to John's house to show everyone.

(33) John doesn't have a baby. But Theo is a new father, so ?? Theo brought *the baby John doesn't have* to John's house to show everyone.

But a parallel problem can be spelled out in Heim's framework on the basis of sentences like (34):

(34) John has a baby and loves the baby. ?? Theo is a new father too, so Theo brought it to John's house to show everyone.

In Heim's framework, as far as we can tell, we should be able to spell out the 'it' in (34) as *the baby* (thanks to Heim's rule that 'If the antecedent is definite (i.e., a name, pronoun, demonstrative or definite description), the pronoun is replaced by a copy of the antecedent'). Then (34) should be interpreted as (35):

(35) John has a baby and loves the baby. Theo has a baby too, so Theo brought the baby to John's house to show everyone.

Once more, we cannot argue that the 'it' in (34) is simply too far from its antecedent, since examples like (36) show that there is no problem in general licensing anaphora across this kind of distance: in (36), the 'it' must have 'the baby' as its antecedent.

(36) John has a baby and loves the baby. Theo likes babies too, so John brought it to Theo's house to show him.

We cannot argue that there is no solution to the formal link. What we can say at this point is that the most prominent approaches do not work. This is at least suggestive that the formal link is a problem which it is better not to have in the first place.

8.2 MINIMALITY AND NUMBER

As we discussed above, e-type theories have a well-known *prima facie* problem with uniqueness. If 'the φ' or 'it [~~the φ~~]' presupposes there is a unique φ, then what do we make of sentences like Heim's (37)?

(37) Everyone who bought a sage plant bought eight others along with it.

The issue, again, is that we could not possibly accept (37) together with a presupposition that everyone who bought a sage plant bought a unique sage plant.

This problem initially led Heim and others to reject the e-type approach. But, as we discussed above, later work showed that e-type theories have the resources to deal with this problem by working with an ontology of *minimal situations*. The thought is that the uniqueness presupposition of a definite 'the φ' (and therefore also of a pronoun) must be satisfied, but it can be satisfied by a *minimal* situation—one in which we are essentially ignoring all the other φ things there are. So (37) ends up meaning: 'Every minimal situation x in which someone bought a [single] sage plant can be expanded into a situation y in which that person bought eight others along with *the unique sage plant in x'*.

So far so good. But this move to minimal situations creates a problem which to our knowledge hasn't been observed. Consider the following:

(38) ??Usually when one or more dogs is in the house, the dog slobbers all over me.

(38) sounds quite weird. But, because of its reliance on minimal situations, (38) is predicted by e-type theories to be semantically equivalent to (39):

(39) Usually when a dog is in the house, the dog slobbers all over me.

This is because according to e-type theories, when we evaluate (38), we only care about *minimal* situations that contain one or more dog. But any such situation will of course contain just one dog. And those are just the situations that matter for the evaluation of (39). So what could explain the intuition that there is something off about (38)?

One possibility is that, even though (38) and (39) are indeed semantically equivalent, there is some mismatch between the number features on the NP in the restrictor of (38) ('dogs') as compared with the definite in the consequent ('the dog'). This mismatch would have to be syntactically driven, since, again, these two sentences are predicted to be semantically equivalent. Maybe there is a story to tell here, but we don't know of one.

Dynamic semantics, of course, has no problems along these lines, because dynamic semantics eschews uniqueness altogether, and so does not need to say anything about minimality: according to dynamic semantics, 'one or more'

does not introduce a singular discourse referent (we won't get into what exactly dynamic semantics *should* say about this contrast, which is not an easy question; our point is just that dynamic semantics is not locked into treating these as equivalent).

9 CONCLUSION

This does not exhaust the possible comparisons between dynamic situation e-type semantics and dynamic semantics. The most important missing point of comparison is the problem of *indistinguishable participants*: the question of whether and how situation semantics can account for sentences like (40)

(40) When a bishop meets a bishop, he blesses him.

For reasons of space—and because we don't have much new to say here—we will not get into this problem. Our aim here has been the fairly modest one of showing that, even once we adopt a dynamic conjunction in a situation framework, there are still important differences between situation semantics and dynamic semantics. We have given some reason to think that these differences favor dynamic semantics: the latter avoids two problems for the former, the well-known problem of the formal link, and the less known problem of minimality and number, both of which we argued remain open for situation semantics.

But our deeper goal here is not to argue conclusively against a situation semantics approach to donkey anaphora, but rather to get clearer on what that approach must look like. We have addressed two issues which have remained in the background in the situation literature: first, the question of how presuppositions project out of quantifiers in situation semantics; second, the (closely related) question of what conjunction should look like in situation semantics. We have argued that, given a defensible answer to the first question, situation semantics must adopt a conjunction which is strikingly similar to the sequential-update conjunction characteristic of dynamic semantics. This means that, as far as their treatment of connectives goes, situation semantics and dynamic semantics are much closer than has previously been recognized. It also means that there is no major extant theory of anaphora which can maintain a classical approach to conjunction.

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